Claims

What is claimed is:

1. A method of casting a part, comprising:

forming a shell mold around a pattern fabricated from an expendable material;

removing the pattern from the shell mold;

locating the shell mold within a housing such that an inlet port of the shell mold communicates with an opening in the housing;

providing a supporting material that substantially fills an open volume between an external surface of the shell mold and an interior surface of the housing; and

pressure casting a molten material through the inlet port and into the shell mold.

2. The method of claim 1, wherein the pressure casting step further includes introducing the molten material into the shell mold at a non-turbulent flow velocity.

3. The method of claim 1, wherein the molten material is introduced into the shell under a pressure of from about 100 psi to about 10,000 psi.

4. The method of claim 1, further including removing and recycling the supporting material.

5. The method of claim 4, further including removing the shell mold from the part.

6. The method of claim 1, wherein the expendable material includes wax.

7. The method of claim 1, wherein the expendable material includes evaporative foam.

8. The method of claim 1, wherein the shell mold includes a refractory material.

9. The method of claim 1, wherein the supporting material is a granular material.

10. The method of claim 1, wherein the supporting material is a low melting point metallic alloy.

11. The method of claim 10, wherein the low melting point metallic alloy achieves volume expansion upon solidification.

12. The method of claim 1, wherein the shell mold includes re-entrant features.

13. A method of casting a part, comprising:

providing a shell mold having an inlet port;

locating the shell mold within a housing such that the inlet port of the shell mold communicates with an opening in the housing;

providing a supporting material that substantially fills an open volume between an external surface of the shell mold and an interior surface of the housing;

pressure casting a molten material through the inlet port and into the shell mold;

removing the supporting material from the housing; and

removing the shell mold containing the part from the housing and removing the part from the shell mold.

14. The method of claim 13, wherein the shell mold has a wall thickness of between about 4 mm to about 8 mm.

15. The method of claim 13, wherein the supporting material is a granular material.

16. The method of claim 13, wherein the supporting material is a metallic alloy and is removed by melting and draining the metallic alloy from the housing.

17. A method of casting a part, comprising:

forming a refractory shell mold around a pattern fabricated from an expendable material;

locating the refractory shell mold within a housing such that an inlet port of the refractory shell mold extends through an opening in the housing;

providing a supporting material that substantially fills an open volume between an external surface of the shell mold and an interior surface of the housing;

placing the housing into a die cavity of a pressure casting apparatus such that an inlet sprue of the pressure casting apparatus mates with the inlet port of the refractory shell mold;

introducing a molten material into the refractory shell mold at a non-turbulent flow velocity and under a pressure of from about 100 psi to about 10,000 psi;

removing the housing from the die cavity;

removing the supporting material; and

removing the refractory shell mold from the part.

18. The method of claim 17, wherein the step of forming the refractory shell mold further includes heating the refractory shell mold to remove the pattern and sintering the refractory shell mold.

19. The method of claim 17, wherein the refractory shell mold includes re-entrant features.

20. A mold assembly useful with a pressure casting apparatus, comprising:

a housing including an interior volume and an opening through a wall of the housing;

a refractory shell mold having an internal mold cavity and an inlet port providing access to the internal mold cavity, said refractory shell mold being disposed within the interior volume of the housing such that the inlet port communicates with the opening; and

a metal alloy substantially filling a volume between an external surface of the refractory shell mold and the housing.

21. The mold assembly of claim 20, wherein said housing is configured to mate with a die cavity of the pressure casting apparatus, and the inlet port is configured to accept an inlet sprue from the pressure casting apparatus.

22. The mold assembly of claim 20, wherein said refractory shell mold includes at least one of alumina and zirconia.

23. The mold assembly of claim 20, wherein said metal alloy has a melting temperature of no greater than about 300°C.

24. The mold assembly of claim 23, wherein the metal alloy includes at least one of lead, bismuth, and antimony.

25. The mold assembly of claim 20, wherein the refractory shell mold includes re-entrant features.

26. A casting system comprising:

a pressure casting apparatus having an inlet sprue and a die cavity; and

a mold assembly configured to fit within the die cavity, said mold assembly including:

a housing including an interior volume and an opening through a wall of the housing;

a refractory shell mold disposed within the interior volume of the housing, the refractory shell mold having an internal mold cavity and an inlet port that communicates with the opening in the housing and mates with the inlet sprue; and

a supporting material substantially filling a volume between an external surface of the refractory shell mold and the housing.

27. The casting system of claim 26, wherein the housing is formed of steel.

28. The casting system of claim 26, wherein said housing is dimensioned such that a gap of no more than about 0.3 mm exists between all corresponding surfaces of the housing and the die cavity.

29. The casting system of claim 26, wherein the supporting material includes a granular material.

30. The casting system of claim 29, wherein the mold assembly further includes a compaction plate in communication with the housing and the supporting material.

31. The casting system of claim 29, wherein the granular material includes at least one of carbon particles, alumina-based sand, zirconia-based sand, and metal particles.

32. The casting system of claim 26, wherein the supporting material includes a low melting point metallic alloy.

33. The casting system of claim 32, wherein the metallic alloy includes at least one of lead, bismuth, and antimony.

34. The casting system of claim 26, wherein the refractory shell mold includes re-entrant features.

35. A method of casting a part, comprising:

forming a shell mold around a pattern fabricated from an expendable material;

removing the pattern from the shell mold;

locating the shell mold within a die cavity of a pressure casting apparatus such that an inlet port of the shell mold communicates with an inlet sprue of the pressure casting apparatus;

providing a supporting material that substantially fills an open volume between an external surface of the shell mold and an interior surface of the die cavity; and

pressure casting a molten material through the inlet port and into the shell mold.

36. The method of claim 35, wherein the pressure casting step further includes introducing the molten material into the shell mold at a non-turbulent flow velocity.

37. The method of claim 35, wherein the molten material is introduced into the shell under a pressure of from about 100 psi to about 10,000 psi.

38. The method of claim 35, wherein the shell mold includes a refractory material.

39. The method of claim 35, wherein the supporting material is a granular material.

40. The method of claim 35, wherein the supporting material is a low melting point metallic alloy.

41. The method of claim 40, wherein the low melting point metallic alloy achieves volume expansion upon solidification.

42. A method of casting a part, comprising:

providing a shell mold having an inlet port;

covering the shell mold with a supporting material;

locating the shell mold within a die cavity of a pressure casting apparatus such that the inlet port of the shell mold communicates with an inlet sprue of the pressure casting apparatus; and

pressure casting a molten material through the inlet port and into the shell mold.

43. The method of claim 42, wherein the supporting material is a self-supporting granular material that is shaped to substantially fill a volume within the die cavity external to the shell mold.

44. The method of claim 43, wherein the self-supporting granular material includes a granular media and a binder material.

45. The method of claim 42, wherein the supporting material is a low melting point metallic alloy shaped to substantially fill a volume within the die cavity external to the shell mold.